CRS - EXPLOITING & OPTIMIZING THE TECHNOLOGY

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INTRODUCTION:

This document will outline the implementation of the Console Replacement System (CRS) at WFO Wichita KS (ICT) and the important lessons learned in that process. CRS has met with fewer "objections" at ICT than what has been reported at other locations around the country. By sharing these insights, we (ICT) hope that this information will be useful to other offices as they expand the use of CRS. It is our premise that the current voice, while not perfect, has been unfairly labeled as a poor quality implementation of voicing technology. This document will also explore the primary issues that appear to affect the quality of any text-to-speech implementation. It is not our intention to promote either the DecTalk card, or any specific CRS formatter, but to outline how we made the best of what we have to work with (and around).

DEPLOYMENT:

Pre-Arrival:
Before CRS ever went on the air, our first step was a public relations campaign. The first (and most important) speaking point was that the voice didn't sound exactly like a person. We admitted it would be difficult to understand at first and would take some "getting used to." We told everyone that it would improve our operations, and would allow us to get products on the air *faster and more reliably.* These points were conveyed at spotter talks and also broadcast on NOAA Weather Radio (NWR).

Upon Arrival:
It was immediately obvious that the dictionary needed words added or modified to match local pronunciations. Using a geographical pronunciation gazetteer, all the towns in and around the forecast area were checked.   Fine tuning this dictionary remains a continual process as new words are used and the number of products we automate increases. (For reference, we currently have more than 1000 words in the dictionary.)

Implementation:
The implementation was gradual, starting with promos introducing the voice. These messages acknowledged the unusual voice and the advantages of automation. The hourly weather roundup was the first product to be automated. (The amount of automation has continued to increase as additional formatters have been developed. Currently everything is automated except some select climate information, river products and some adjacent office products.)

To make "the voice" more personal, we conducted a "Name the Voice" contest. Using "The CRS Voice," we solicited NWR listeners to write or e-mail us a name for the voice. The winner received a rain gauge. We had more than 200 entries. The winning entry was Chance R.

Storm. The name is frequently used in promotional messages. The hourly weather lead-in is: "This is Chance Storm with a look at weather conditions at hh AM..."

Early Software Configuration:
The first step was to verify all local geographical names were correctly pronounced. Numerous cities, counties, creeks and rivers were added to the CRS dictionary. As more products were automated, it became clear that additional CRS software configuration was required. One of the changes was to increase the speech rate. This produced the *single largest improvement* to the overall quality of the broadcast. The optimal rate at ICT is about 207 words per minute, although this will vary by regional dialect/preference. However as rate decreases, it seems that the quality of the voice decreases rapidly. Numerous comments were received from individuals about how much better Chance sounded at the higher rate. Many did not realize the improvement was primarily the result of the increased rate. (In a NWR listener survey, one individual even mistakenly stated that voice improved, but thought slowing it down would make it even better. The only significant change at that point had been the rate increase.) Other minor adjustments to the voice parameters have been made. A table of our current voice settings is provided in Appendix A.

Phrasing:
During the initial deployment of CRS, ICT uncovered a bug in the hardware/software interaction that ultimately required on-site diagnosis/correction by leading experts from NEC, DecTalk and the CRS programming group. We had the opportunity to discuss the DecTalk card nuances with Mr. Tom Kopec, the on-site DecTalk expert. He shared some valuable insights. We asked him what could be done to improve the voicing. He suggested keeping phrases short and simple. He also stated that over time, people will become more familiar with the voice. In cases where reception is less than optimal, frequent listeners will be able to distinguish the automated voice better than a human voice. The DecTalk card has been used to automate marine weather reports on shortwave radio. He stated that after initial opposition, it has become favored by the majority of frequent users since it is easier to understand in marginal reception. Comments received to date seem to validate his observations.

Based on local observations and testing, the voicing relies on a fixed inflection/emphasis at the beginning and ending of EVERY PHRASE, regardless of length. Any text in the middle of the phrase is essentially monotone. This has two extremely important implications.

> 1. ***One word phrases MUST be avoided. Period.*** The DecTalk card will put the emphasis/inflection on both the beginning and ending of the single word, hammering its pronunciation. A common problem occurs with phrases like: "however..." = howEVer, "Tonight..." = toNIght, "Tomorrow..." = toMARoh, ...Iowa... = EYE oh Wah. Each of these will be poorly voiced on CRS. (Listen to it at: *http://www.crh.noaa.gov/ict/crs/ex_today.wav*) Because these one word phrases at the start of a sentence are used so frequently, we have the various formatters automatically remove the ellipses or commas after the single word.

> 2. ***There is an optimal phrase length that should be used in all products.*** The "acceptable" phrase length in an AWIPS text window product editor, appears to range from about one half to one line plus a word or two in the AWIPS text editor. Anything longer will sound monotone. *The "optimal" range is about one half to one line long.* **NEVER use one word phrases.**

Often, we (human voices) add subtle pauses, which are not part of the official product text. For CRS to sound natural, commas/ellipses must be inserted in these locations, either in the product before transmission (preferred) or manually after it is CRS formatted. For example:

> "HIGHS WILL RANGE FROM THE UPPER 40S OVER NEBRASKA TO THE MID 60S OVER OKLAHOMA."   (Listen to it at:
> *http://www.crh.noaa.gov/ict/crs/temp_1.wav*)

If you were to read this, you would momentarily pause after Nebraska, even though there is no comma. It will sound much better on CRS if a comma or ellipse is added after Nebraska. (Listen to it at: *http://www.crh.noaa.gov/ict/crs/temp_2.wav*)

Unusual/quirky sentence construction should also be avoided. While a human is able to add additional pauses, inflection and emphasis to make it sound correct, the CRS voice cannot. Simple sentences will sound best on the radio, even if they are stylistically childish in their construction.

This requires everyone to keep CRS in mind when composing products. Simple changes can make huge differences in the way CRS sounds.   This may be as simple as changing:

> "RAIN IS FORECAST OVER NEBRASKA...IOWA...MISSOURI...AND EASTERN KANSAS."   (Listen to it at: *http://www.crh.noaa.gov/ict/crs/rain_1.wav*)

to:

> "RAIN IS FORECAST OVER NEBRASKA...EASTERN KANSAS...IOWA AND MISSOURI."   (Listen to it at: *http://www.crh.noaa.gov/ict/crs/rain_2.wav*)

While there is no difference in meaning, note the difference in the way Missouri and Iowa are pronounced. Except in cases where the preceding phrase is long, the ... before the word AND should be eliminated. This punctuation is no longer "mandated" by "standard" rules of English punctuation, and the improvement in voicing on CRS can be substantial.

CRS FORMATTERS:

Formatters at ICT:
It is beyond the scope of this document to list every "customization" we've made to every formatter in use at ICT. However we will mention a few specifics that, regardless of formatter, have widespread applicability.

TODAY.... = TODAY
TONIGHT... = TONIGHT
HOWEVER... = HOWEVER
ALTHOUGH... = ALTHOUGH
I-35 = I 35   (would otherwise say "I dash thirty five")
I-235 = I 2 35   (would otherwise say "I dash two hundred thirty five")
PM CDT = PM   (We are not close to a time zone border and it lengthens
AM CST = AM   the broadcast unnecessarily.)

We have used the native AWIPS formatters whenever possible. One of the biggest challenges has been the WarnGen templates. The WarnGen formatter has required careful placement of ellipses throughout the template. So far we have been able to stay within the bounds dictated by OML C-40.   However it has been a challenge. In addition, we have relied upon the substitution mechanism in WWA (used by WarnGen) to substitute words/phrases/punctuation in CRS warnings to make it sound more natural on CRS.   A table listing the CRS formatters in use at ICT is provided in Appendix B.

Future OMLs, ROMLs and software developers should keep these CRS composition "rules" in mind. Unless phrasing and sentence construction is optimized, **ANY** of the current voicing systems will sound poor. A typical example of not considering CRS formatters is the AWIPS CRS Climate formatter. The CRS output of the date is "xx Month Year."   So the phrase "22 April 2000" is read "Twenty two April two thousand."   However the DecTalk system is internally programmed to read dates like "April 22 2000" as "April twenty second, two thousand."   Another example is the Interactive Computer Worded Forecast (ICWF) Specific Area Forecast (SAF), (the ICWF CRS zone product), which keeps the ellipses after every period label in the zones. (TODAY..., TOMORROW..., etc.) These should be eliminated, because they are one word phrases at the beginning of a sentence.

THE FUTURE:

Where Are We Going at ICT?:
The current focus is in two areas.

1. Continue tweaking words in the dictionary. (Currently we have just over 1000 entries.) A few words have defied our best efforts to get proper pronunciation (cities of Eldorado, Olathe, etc.).

2. Ongoing effort to educate staff in optimal wording for CRS. This does not mean changing the intended meaning of a sentence, but saying it in such a way to optimize the quality on CRS. It's not difficult, but does require a paradigm shift.

RECOMMENDATIONS:

1.Those developing CRS formatters or establishing product formats, should be extremely sensitive to CRS format "requirements."   Products should be in a format that allows easy conversion to CRS text. Formatters should convert products into a high quality (speech optimized) CRS text automatically.

2. Develop a comprehensive set of training materials to educate everyone on "CRS friendly product composition."   This is needed NWS wide, but the material could also be incorporated into the NWS Training Center RTM-500, "Clear and Effective Communication."

CONCLUSION:

The current CRS hardware and software, when tweaked correctly, can provide satisfactory output. There are two primary issues that must be addressed. The software must be tweaked to provide as naturally sounding words as possible (vocabulary/dictionary, rate, pitch, etc.) Second, the text broadcast must be optimized for synthesized speech (avoid both one word and very long phrases). Of note, the second issue appears to be a common problem with most, if not all text-to-speech implementations.

ACKNOWLEDGMENTS:

APPENDIX A:

VOICE SETTINGS (In the Transmitter Menu, under Voice Parameters)	
Voice	Standard Male Voice
Volume	15
Rate	207
Baseline Fall	60
Hat Rise	6
Stress Rise	40

APPENDIX B:

CRS Formatters in use at WFO-ICT:	
ICWF	ZFP
WWA	NPW, WSW, FFA
WarnGen	TOR, SVR, FFW
AWIPS Climate	(Run at midnight only, airs at 7 AM)
Snuffle	SPS, SVS, FFS, PNS, AWS, TVL, SLS
WR-NOW (Ron Miller Perl script)	NOW
RFD (Locally developed)	KS Rangeland Fire Danger Index
xtp2crs (Locally developed)	RTP/STP climate formatter